

**SOLID-STATE LIGHTING:****Solid-State Lighting Patents Resulting from DOE-Funded Projects**

As of January 2012, 45 SSL patents have been awarded to research projects funded by the U.S. Department of Energy. Since December 2000, when DOE began funding SSL research projects, a total of 139 patent applications have been submitted, ranging from large businesses (40) and small businesses (56) to universities (36) and national laboratories (7).

Primary Research Organization	Titles of Patent Applications (Bold indicates patents that were granted)	
<b>Agiltron, Inc.</b>	<ul style="list-style-type: none"> <li>• <b>Optoelectronic Device With Nanoparticle Embedded Hole Injection/Transport Layer</b></li> </ul>	<ul style="list-style-type: none"> <li>• Air-Stable, Cross-Linkable Hole Transport Materials for Organic Light Emitting Devices</li> </ul>
<b>Arkema, Inc.</b>	<ul style="list-style-type: none"> <li>• OLED Substrate Consisting of Transparent Conductive Oxide (TCO) and Anti-Iridescent Undercoat</li> </ul>	<ul style="list-style-type: none"> <li>• Chemical Vapor Deposition Using N<sub>2</sub>O Polydentate Ligand Complexes of Metals</li> </ul>
<b>Boston University</b>	<ul style="list-style-type: none"> <li>• <b>Optical Devices Featuring Textured Semiconductor Layers</b></li> <li>• Formation of Textured III-Nitride Templates for the Fabrication of Efficient Optical Devices</li> </ul>	<ul style="list-style-type: none"> <li>• Formation of Textured III-Nitride Templates for the Fabrication of Efficient Optical Devices</li> <li>• Nitride LEDs Based on Flat and Wrinkled Quantum Wells</li> </ul>
<b>Cree, Inc.</b>	<ul style="list-style-type: none"> <li>• <b>Light Emitting Diode with Porous SiC Substrate and Method for Fabricating</b></li> <li>• <b>LED Package Element with Internal Meniscus for Bubble-Free Hallow Floating Lens Placement</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Light Emitting Diode with High Aspect Ratio Sub-Micron Roughness for Light Extraction and Methods of Forming</b></li> <li>• <b>Expandable LED Array Interconnect</b></li> <li>• Ultra-Thin Ohmic Contacts for P-type Nitride Light Emitting Devices</li> </ul>
<b>Crystal IS, Inc.</b>	<ul style="list-style-type: none"> <li>• Growth of Large Aluminum Nitride Single Crystals with Thermal-Gradient Control</li> </ul>	<ul style="list-style-type: none"> <li>• Growth of Large Aluminum Nitride Single Crystals with Thermal-Gradient Control</li> </ul>
<b>Dow Corning</b>	<ul style="list-style-type: none"> <li>• Method of Forming Three-Dimensional Silicon-Containing Structures</li> <li>• Three other patent applications filed</li> </ul>	
<b>Eastman Kodak</b>	<ul style="list-style-type: none"> <li>• <b>Ex-Situ Doped Semiconductor Transport Layer</b></li> <li>• <b>Doped Nanoparticle-Based Semiconductor Junction</b></li> <li>• <b>Device Containing Non-Blinking Quantum Dots</b></li> </ul>	<ul style="list-style-type: none"> <li>• Light-Emitting Nanocomposite Particles</li> <li>• Making Colloidal Ternary Nanocrystals</li> </ul>
<b>Fairfield Crystal Technology</b>	<ul style="list-style-type: none"> <li>• Method and Apparatus for Aluminum Nitride Monocrystal Boule Growth</li> </ul>	
<b>GE Global Research</b>	<ul style="list-style-type: none"> <li>• <b>Light-Emitting Device with Organic Electroluminescent Material and Photoluminescent Materials</b></li> <li>• <b>Luminaire for Light Extraction from a Flat Light Source</b></li> <li>• <b>Mechanically Flexible Organic Electroluminescent Device with Directional Light Emission</b></li> <li>• <b>Organic Electroluminescent Devices and Method for Improving Energy Efficiency and Optical Stability Thereof</b></li> <li>• <b>Series Connected OLED Structure and Fabrication Method</b></li> <li>• <b>Organic Electroluminescent Devices Having Improved Light Extraction</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Electrodes Mitigating Effects of Defects in Organic Electronic Devices</b></li> <li>• <b>OLED Area Illumination Source</b></li> <li>• Hybrid Electroluminescent Devices</li> <li>• Lighting System with Thermal Management System</li> <li>• Lighting System with Thermal Management System Having Point Contact Synthetic Jets</li> <li>• Lighting System with Heat Distribution Face Plate</li> <li>• Eight other patent applications filed</li> </ul>
<b>General Electric Lighting Solutions</b>	<ul style="list-style-type: none"> <li>• Two patent applications filed</li> </ul>	
<b>Georgia Tech Research Corporation</b>	<ul style="list-style-type: none"> <li>• One patent application filed</li> </ul>	
<b>International Technology Exchange</b>	<ul style="list-style-type: none"> <li>• One patent application filed</li> </ul>	
<b>Lawrence Berkeley National Laboratory</b>	<ul style="list-style-type: none"> <li>• <b>Carbon Nanotube Polymer Composition and Devices</b></li> <li>• Organic Light Emitting Diodes with Structured Electrodes</li> </ul>	
<b>Lehigh University</b>	<ul style="list-style-type: none"> <li>• <b>Gallium Nitride-Based Device and Method</b></li> <li>• Staggered Composition Quantum Well Method and Device</li> <li>• Staggered Composition Quantum Well Method and Device</li> </ul>	
<b>Light Prescriptions Innovators</b>	<ul style="list-style-type: none"> <li>• <b>Optical Manifold for Light-Emitting Diodes</b></li> <li>• <b>Optical Manifold for Light-Emitting Diodes</b></li> <li>• <b>Optical Manifold</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Wide Band Dichroic-Filter Design for LED-Phosphor Beam Combining</b></li> <li>• Optical Device for LED-Based Lamp</li> <li>• Three other patent applications filed</li> </ul>

## BUILDING TECHNOLOGIES PROGRAM

Primary Research Organization	Titles of Patent Applications (Bold indicates patents that were granted)	
<b>Lightscape Materials Inc.</b>	<ul style="list-style-type: none"> <li>• Oxycarbonitride Phosphors and Light Emitting Devices Using the Same</li> <li>• Oxynitride-Based Phosphors and Light Emitting Devices Using the Same</li> <li>• Carbonnitride Based Phosphors and Light Emitting Devices Using the Same</li> </ul>	<ul style="list-style-type: none"> <li>• Carbonitride-Based Phosphors</li> <li>• Nitride and Oxynitride Based Phosphors and LED Devices Using the Same</li> <li>• Two other patent applications filed</li> </ul>
<b>Maxdem Incorporated</b>	<ul style="list-style-type: none"> <li>• Polymer Matrix Electroluminescent Materials and Devices</li> </ul>	
<b>Nanosys</b>	<ul style="list-style-type: none"> <li>• <b>Nanocrystal Doped Matrices</b></li> </ul>	
<b>OSRAM Opto Semiconductors, Inc.</b>	<ul style="list-style-type: none"> <li>• <b>Integrated Fuses for OLED Lighting Device</b></li> <li>• <b>Novel Method to Generate High Efficient Devices, Which Emit High Quality Light for Illumination</b></li> <li>• <b>Polymer and Small Molecule Based Hybrid Light Source</b></li> <li>• OLED with Phosphors</li> </ul>	<ul style="list-style-type: none"> <li>• Thermal Trim for a Luminaire</li> <li>• Novel Method to Generate High Efficient Devices, Which Emit High Quality Light for Illumination</li> <li>• Polymer Small Molecule Based Hybrid Light Source</li> <li>• One other patent application filed</li> </ul>
<b>Pacific Northwest National Laboratory</b>	<ul style="list-style-type: none"> <li>• <b>OLED Devices</b></li> <li>• Organic Materials with Phosphine Sulphide Moieties Having Tunable Electric and Electroluminescent Properties</li> </ul>	<ul style="list-style-type: none"> <li>• Organic Materials with Tunable Electric and Electroluminescent Properties</li> </ul>
<b>Philips Electronics North America</b>	<ul style="list-style-type: none"> <li>• High Color-Rendering-Index LED Lighting Source Using LEDs from Multiple Wavelength Bins</li> <li>• Three other patent applications filed</li> </ul>	
<b>Philips Lumileds Lighting</b>	<ul style="list-style-type: none"> <li>• Zener Diode Protection Network in Submount for LEDs Connected in Series</li> <li>• LED Module with High Index Lens</li> </ul>	
<b>PhosphorTech Corporation</b>	<ul style="list-style-type: none"> <li>• <b>Light Emitting Device Having Selenium-Based Fluorescent Phosphor</b></li> <li>• <b>Light Emitting Device Having Silicate Fluorescent Phosphor</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Light Emitting Device Having Sulfoselenide Fluorescent Phosphor</b></li> <li>• <b>Light Emitting Device Having Thio-Selenide Fluorescent Phosphor</b></li> </ul>
<b>Purdue University</b>	<ul style="list-style-type: none"> <li>• Metallized Silicon Substrate for Indium Gallium Nitride Light-Emitting Diode</li> </ul>	<ul style="list-style-type: none"> <li>• Process for Fabricating III-Nitride Based Nanopyramid LEDs Directly on a Metallized Silicon Substrate</li> </ul>
<b>RTI</b>	<ul style="list-style-type: none"> <li>• Long-Pass Optical Filter Made from Nanofibers</li> <li>• Stimulated Lighting Devices</li> </ul>	<ul style="list-style-type: none"> <li>• Reflective Nanofiber Lighting Devices</li> <li>• Three other patent applications filed</li> </ul>
<b>Sandia National Laboratories</b>	<ul style="list-style-type: none"> <li>• <b>Cantilever Epitaxial Process</b></li> <li>• <b>Nanowire-Templated Lateral Epitaxial Growth of Non-Polar Group III Nitrides</b></li> </ul>	
<b>Sinmat, Inc.</b>	<ul style="list-style-type: none"> <li>• <b>High Light Extraction Efficiency Solid State Light Sources</b></li> <li>• Chemical Mechanical Fabrication (CMF) for Forming Tilted Surface Features</li> </ul>	
<b>Universal Display Corporation</b>	<ul style="list-style-type: none"> <li>• <b>Binuclear Compounds</b></li> <li>• <b>Organic Light Emitting Device Structure for Obtaining Chromaticity Stability</b></li> <li>• <b>Organic Light Emitting Device Structure for Obtaining Chromaticity Stability</b></li> <li>• <b>Organic Light Emitting Device Architecture for Reducing the Number of Organic Materials</b></li> </ul>	<ul style="list-style-type: none"> <li>• Stacked OLEDs with a Reflective Conductive Layer</li> <li>• Intermediate Connector for Stacked Organic Light Emitting Devices</li> <li>• White Phosphorescent Organic Light Emitting Devices</li> <li>• Organic Light Emitting Device with Conducting Cover</li> <li>• One other patent application filed</li> </ul>
<b>University of California, San Diego</b>	<ul style="list-style-type: none"> <li>• Rare-Earth Activated Nitrides for Solid State Lighting Applications</li> <li>• Two other patent applications filed</li> </ul>	
<b>University of California, Santa Barbara</b>	<ul style="list-style-type: none"> <li>• <b>Plasmon Assisted Enhancement of Organic Optoelectronic Devices</b></li> <li>• Silicone Resin Encapsulants for Light Emitting Diodes</li> </ul>	<ul style="list-style-type: none"> <li>• Enhancing Performance Characteristics of Organic Semiconducting Films by Improved Solution Processing</li> <li>• Six other patent applications filed</li> </ul>
<b>University of North Texas</b>	<ul style="list-style-type: none"> <li>• Organic Light-Emitting Diodes from Homoleptic Square Planar Complexes</li> <li>• Two other patent applications filed</li> </ul>	
<b>University of Southern California</b>	<ul style="list-style-type: none"> <li>• <b>Fluorescent Filtered Electrophosphorescence</b></li> <li>• <b>Fluorescent Filtered Electrophosphorescence</b></li> <li>• <b>OLEDs Utilizing Macrocyclic Ligand Systems</b></li> <li>• <b>Organic Vapor Jet Deposition using an Exhaust</b></li> <li>• <b>Phenyl and Fluorenyl Substituted Phenyl-Pyrazole Complexes of Ir</b></li> <li>• Materials and Architectures for Efficient Harvesting of Singlet and Triplet Excitons for White Light Emitting OLEDs</li> </ul>	<ul style="list-style-type: none"> <li>• Stable Blue Phosphorescent Organic Light Emitting Devices</li> <li>• Organic Light Emitting Device Having Multiple Separate Emissive Layers</li> <li>• Low Index Grids (LIG) to Increase Outcoupled Light from Top or Transparent OLED</li> <li>• One other patent application filed</li> </ul>
<b>Yale University</b>	<ul style="list-style-type: none"> <li>• Conductivity Based Selective Etch for GaN Devices and Applications Thereof</li> </ul>	

### For More Information

For more information on the DOE SSL Project Portfolio, see [ssl.energy.gov/projects.html](https://ssl.energy.gov/projects.html).

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